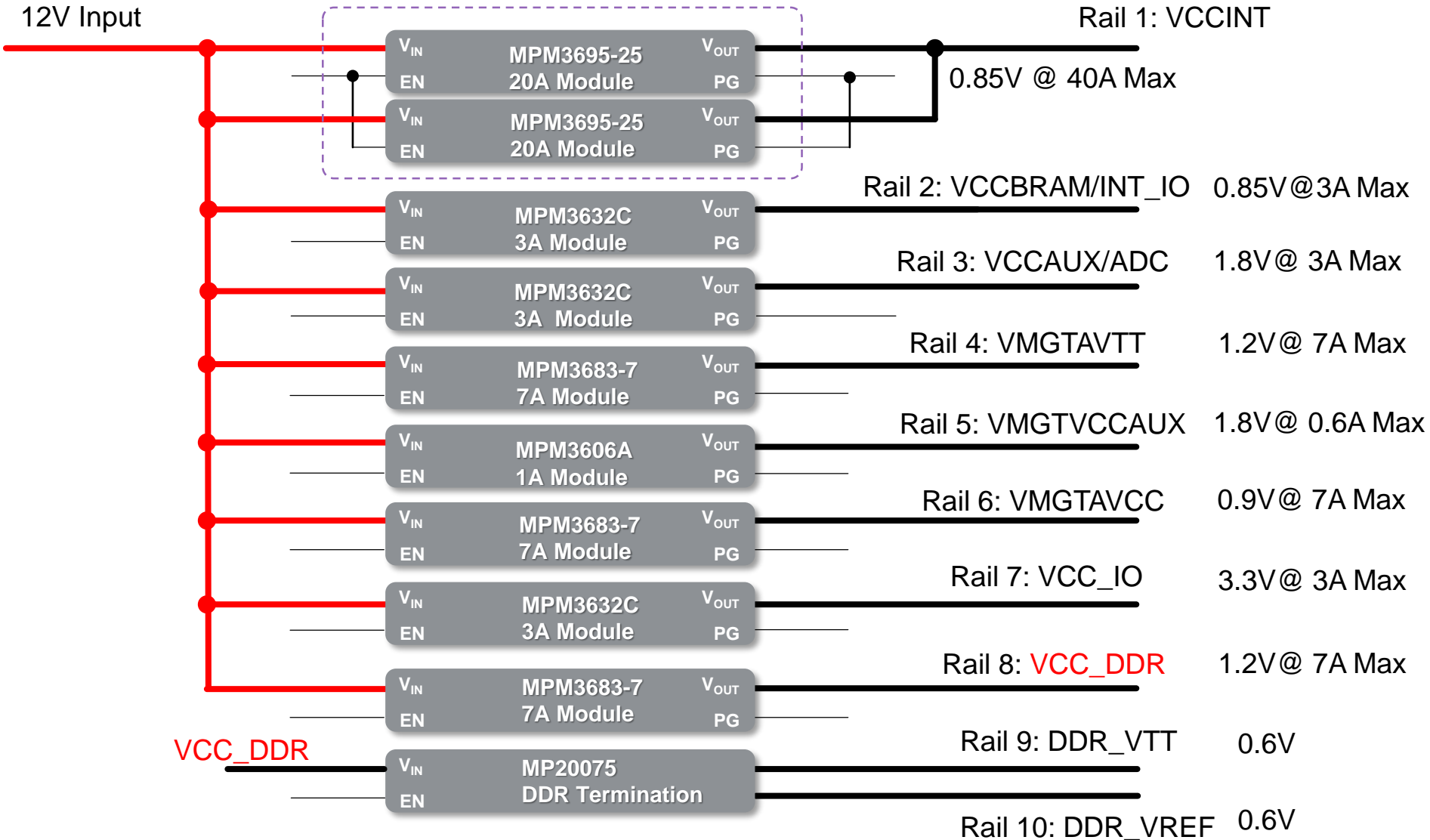


# **MPS Module Solution for Xilinx Kintex UltraScale+ FPGAs**

*Dec 2018*

# Solution Power Tree – High Power Version



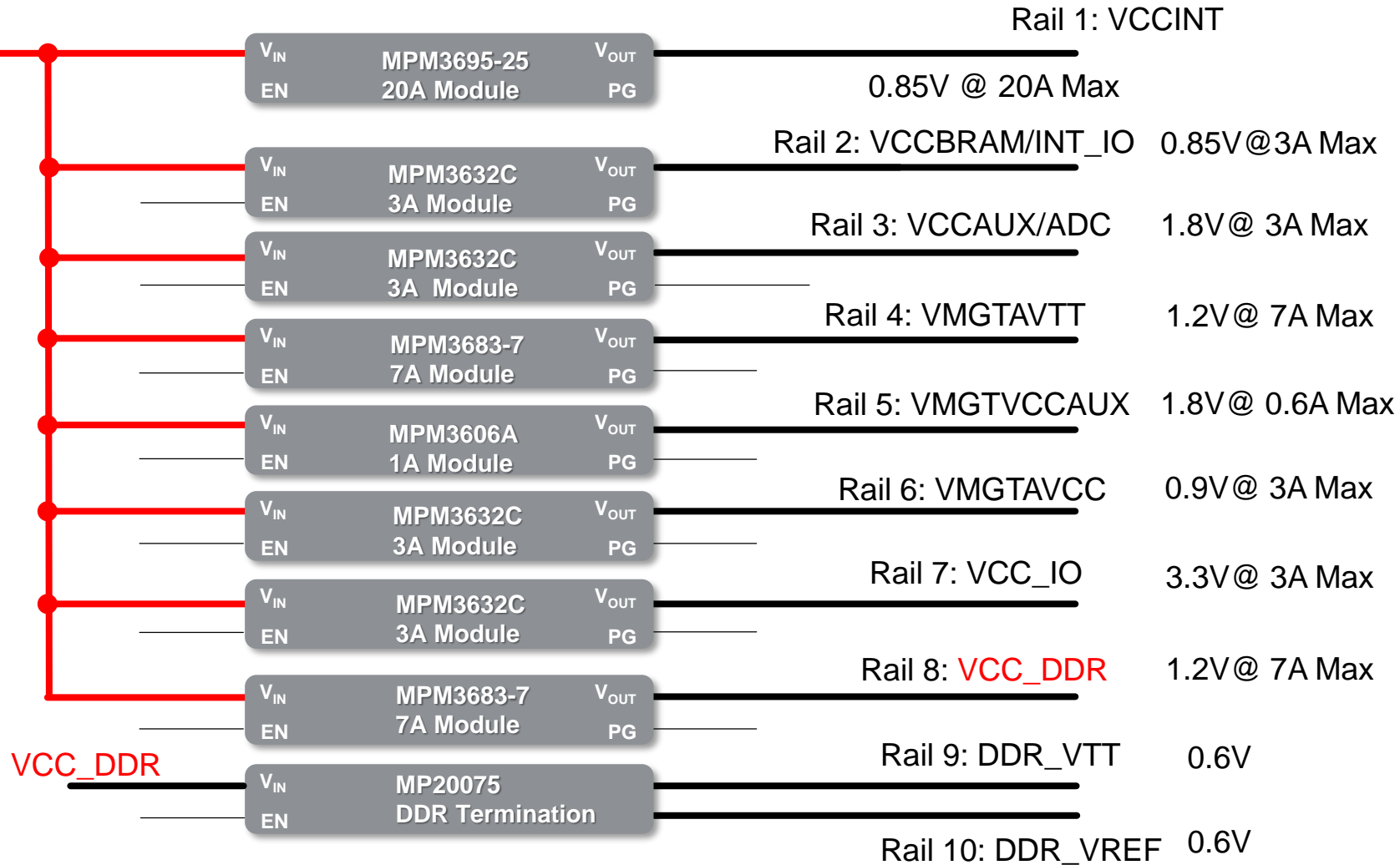
# Summary of High Power Version

Rail Number	Rail Name	VOUT	Limit	Max DC Load	Seq Up	MPS Part#	PCB Area
1	VCCINT	0.85V	±3%	40A	1	MPM3695-25 x2	400 mm <sup>2</sup>
2	VCCBRAM/ VCCINT_IO	0.9V	±3%	3A	2	MPM3632C	24 mm <sup>2</sup>
3	VCCAUX/ADC	1.8V	±3%	3A	3	MPM3632C	24 mm <sup>2</sup>
4	VMGTAVTT	1.2V	±3%	7A	2	MPM3683-7	75 mm <sup>2</sup>
5	VMGTVCCAUX	1.8V	±3%	0.6A	3	MPM3606A	24 mm <sup>2</sup>
6	VMGTAVCC	0.9V	±3%	7A	1	MPM3683-7	75 mm <sup>2</sup>
7	VCC_IO	3.3V	±3%	3A	4	MPM3632C	24 mm <sup>2</sup>
8	VCC_DDR	1.2V	±3%	7A	4	MPM3683-7	75 mm <sup>2</sup>
9	DDR_VTT	VCC_DDR/2	±3%	N/A	4	MP20075	19 mm <sup>2</sup>
10	DDR_VREF	VCC_DDR/2					

Total Solution Size: 689mm<sup>2</sup>



# Solution Power Tree – Low Power Version

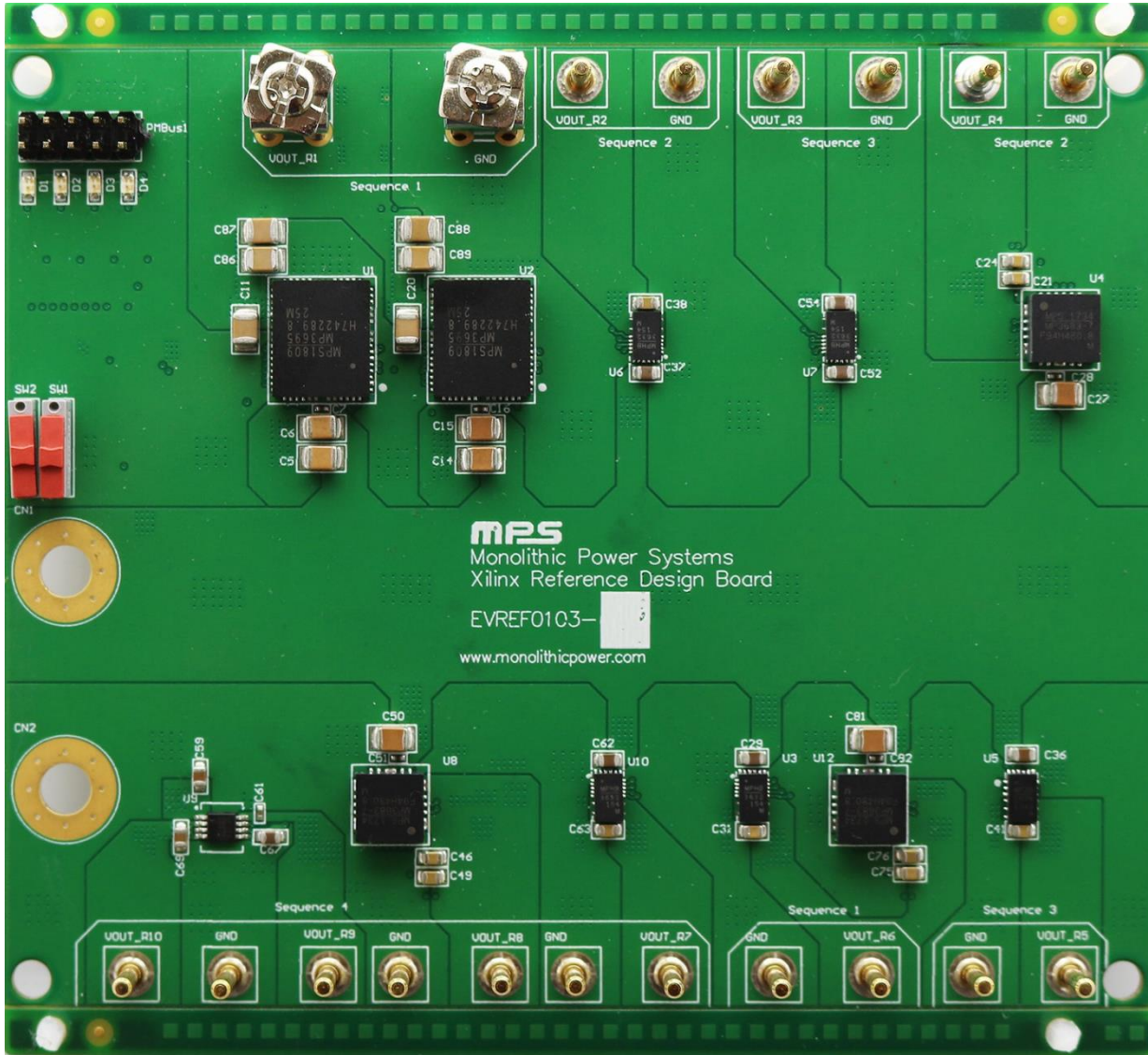


# Summary of Low Power Version

Rail Number	Rail Name	VOUT	Limit	Max DC Load	Seq Up	MPS Part#	PCB Area
1	VCCINT	0.85V	±3%	20A	1	MPM3695-25	200 mm <sup>2</sup>
2	VCCBRAM/ VCCINT_IO	0.9V	±3%	3A	2	MPM3632C	24 mm <sup>2</sup>
3	VCCAUX/ADC	1.8V	±3%	3A	3	MPM3632C	24 mm <sup>2</sup>
4	VMGTAVTT	1.2V	±3%	7A	2	MPM3683-7	75 mm <sup>2</sup>
5	VMGTVCCAUX	1.8V	±3%	0.6A	3	MPM3606A	24 mm <sup>2</sup>
6	VMGTAVCC	0.9V	±3%	3A	1	MPM3632C	24 mm <sup>2</sup>
7	VCC_IO	3.3V	±3%	3A	4	MPM3632C	24 mm <sup>2</sup>
8	VCC_DDR	1.2V	±3%	3A	4	MPM3683-7	75 mm <sup>2</sup>
9	DDR_VTT	VCC_DDR/2	±3%	N/A	4	MP20075	19 mm <sup>2</sup>
10	DDR_VREF	VCC_DDR/2					

Total Solution Size: 438mm<sup>2</sup>

# Reference Design Demo Board Picture

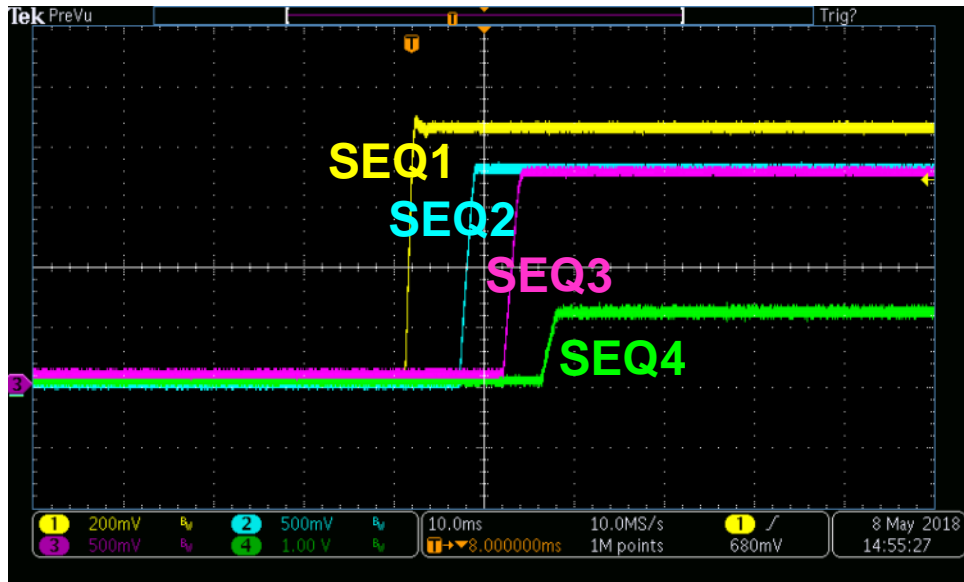


FPGA Series	FPGA P/N	Demo Board P/N	Core Current
Kintex Ultrascale+	KU13P, KU15P	EVREF0103-A	50A Peak
	KU3P, KU5P, KU9P, KU11P	EVREF0103-B	25A Peak

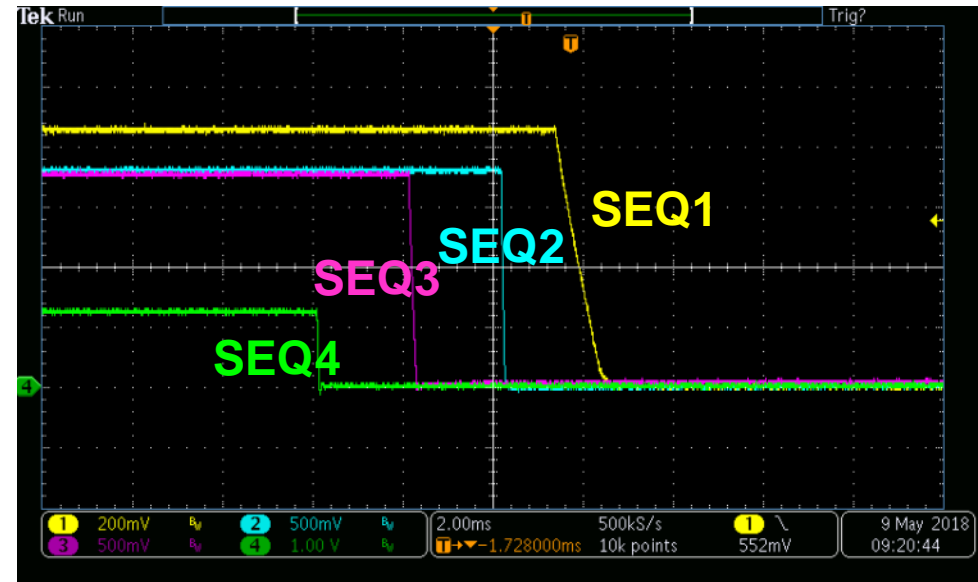
# EVREF0103-A Test Report

# Start up/Shut Down Sequence

Start-up Sequence



Shut-down Sequence

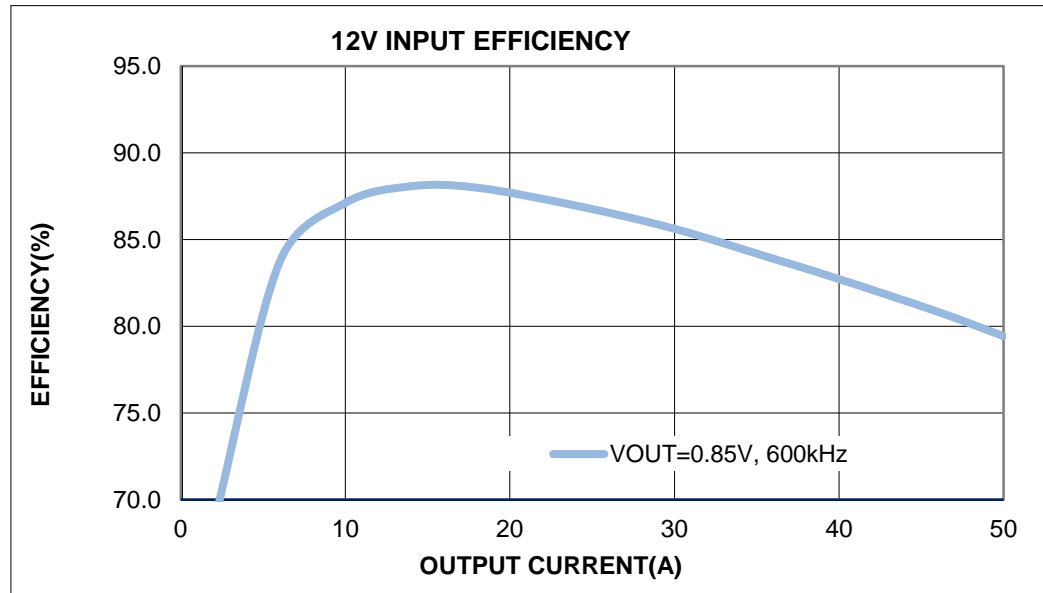




# Rail 1 Efficiency and Transient Results

Testing condition: Dual-phase MPM3695-25,  $V_{IN}=12V$ ,  $V_{OUT}=0.85V$ ,  $f_{SW}=600kHz$ ,  
6 x 100uF ceramic output capacitors per phase + 220uF POSCAP

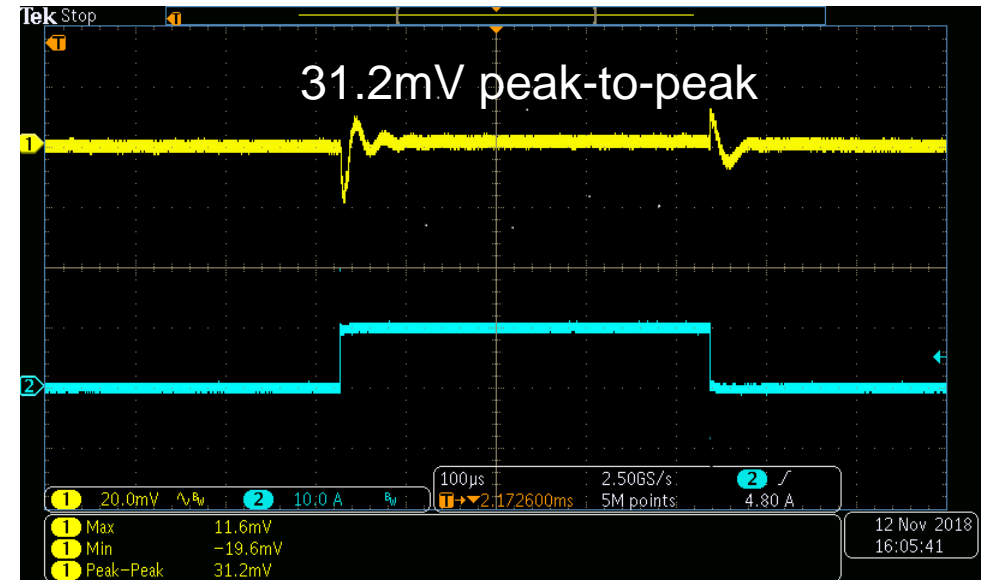
### Efficiency vs. Load Current



CH1:  
 $V_{OUT}/AC$   
Coupled,  
20mV/Div

CH2:  $I_{OUT}$ ,  
10A/Div,

### Load Transient Waveform 25% load step (10A at 100A/us)



100us/div

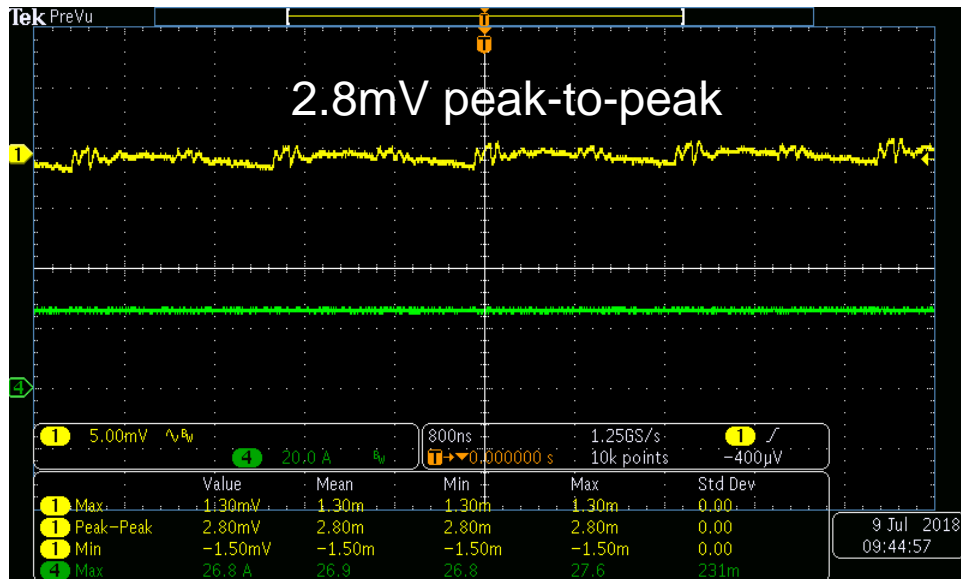
# Rail 1 Output Voltage Ripple

Testing condition: Dual-phase MPM3695-25,  $V_{IN}=12V$ ,  $V_{OUT}=0.85V$ ,  $f_{SW}=600kHz$ ,  
6 x 100uF ceramic output capacitors per phase + 220uF POSCAP

### Output Voltage Ripple at 25A Load

CH1:  
 $V_{OUT}/AC$   
Coupled,  
5mV/Div

CH4:  $I_{OUT}$ ,  
25A/Div

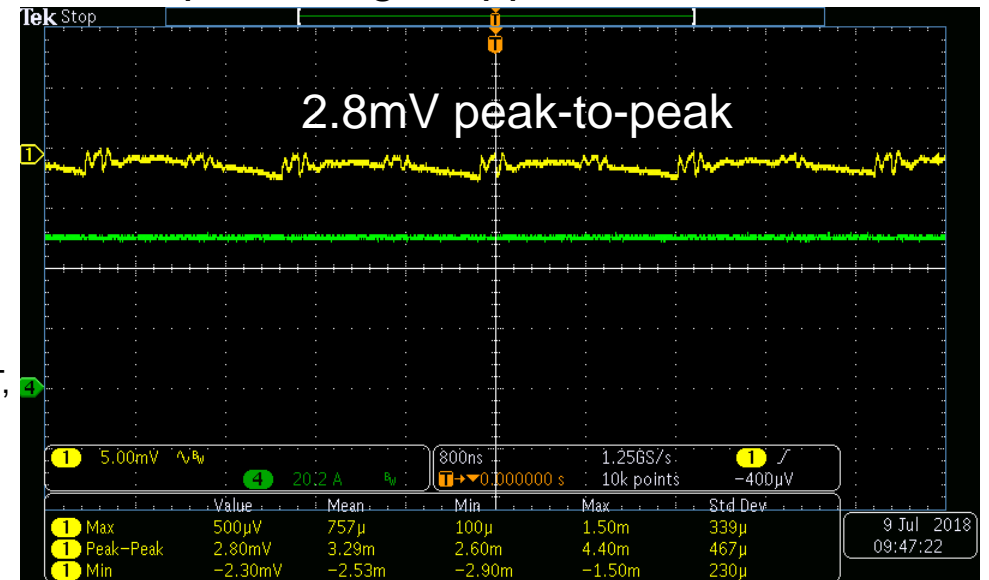


800ns/div

### Output Voltage Ripple at 50A Load

CH1:  
 $V_{OUT}/AC$   
Coupled,  
5mV/Div

CH4:  $I_{OUT}$ ,  
25A/Div

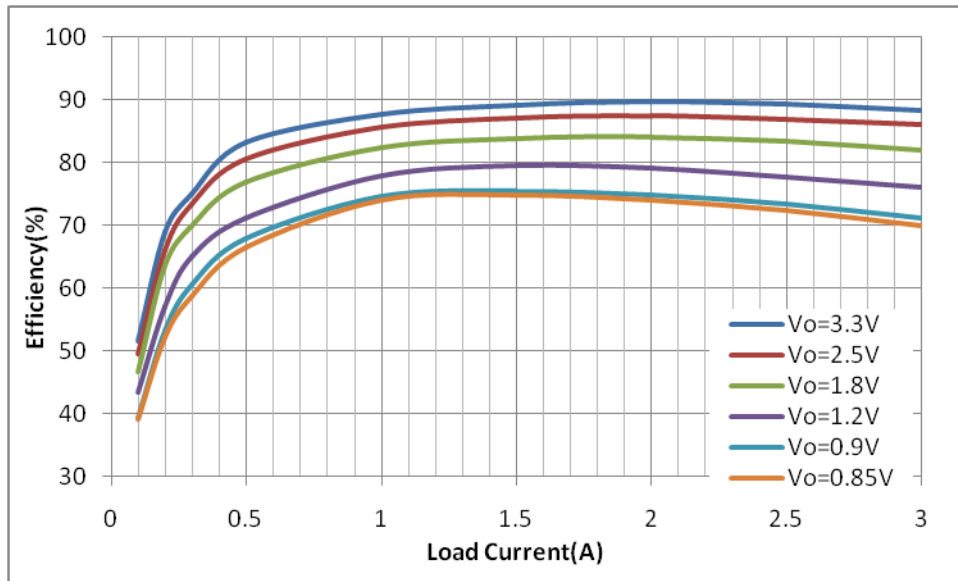


800ns/div

# Rail 2 Efficiency and Transient Results

Testing condition: MPM3632C,  $V_{IN}=12V$ ,  $V_{OUT}=0.9V$ ,  $f_{SW}=3000kHz$ ,  
47uF ceramic output capacitor

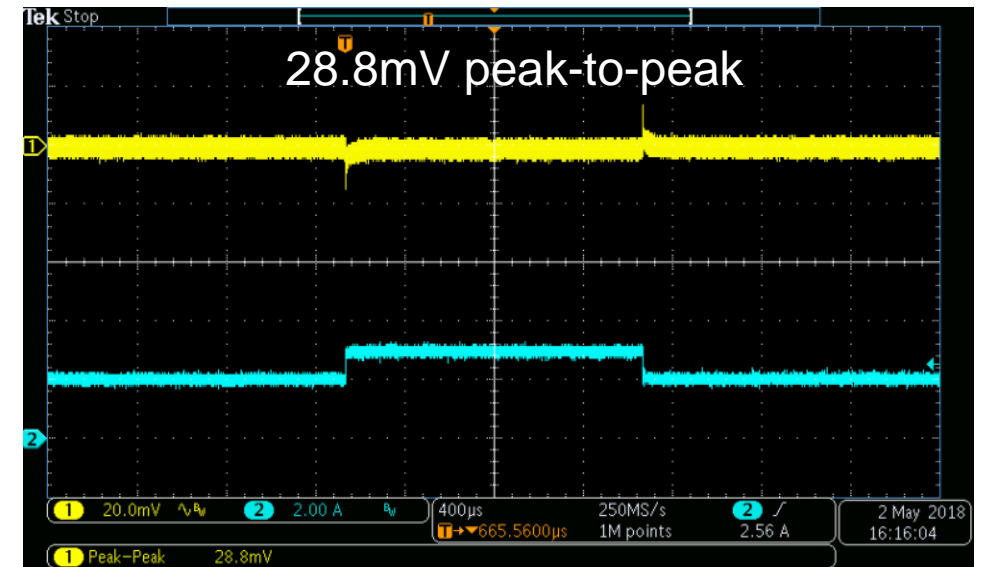
### Efficiency vs. Load Current



### Load Transient Waveform 40% load step (1.2A at 10A/us)

CH1:  
 $V_{OUT}/AC$   
Coupled,  
20mV/Div

CH2:  $I_{OUT}$ ,  
2A/Div



400us/div

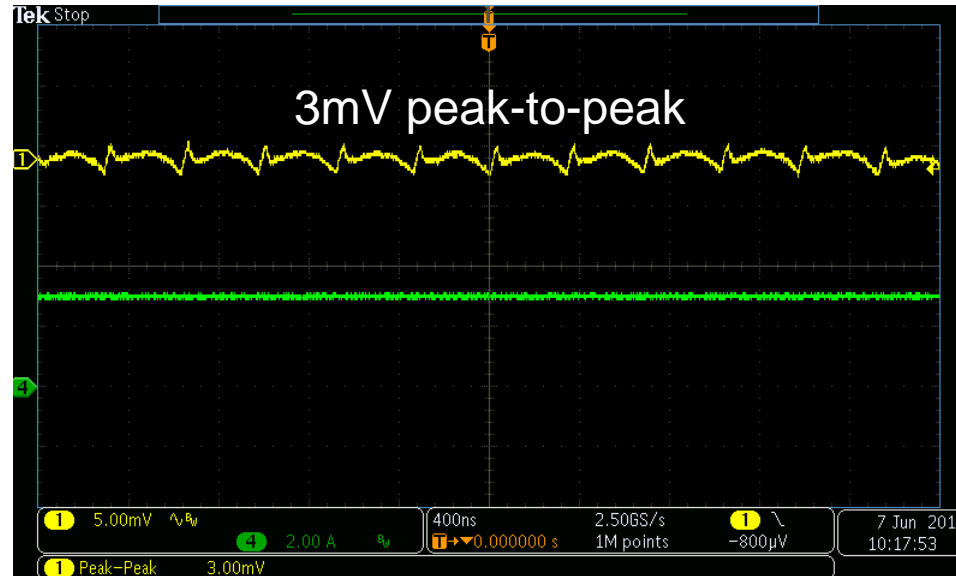
# Rail 2 Output Voltage Ripple

Testing condition: MPM3632C,  $V_{IN}=12V$ ,  $V_{OUT}=0.9V$ ,  $f_{SW}=3000kHz$ ,  
47uF ceramic output capacitors

Output Voltage Ripple at 3A Load

CH1:  
 $V_{OUT}/AC$   
Coupled,  
5mV/Div

CH2:  
 $I_{OUT}$ ,  
2A/Div

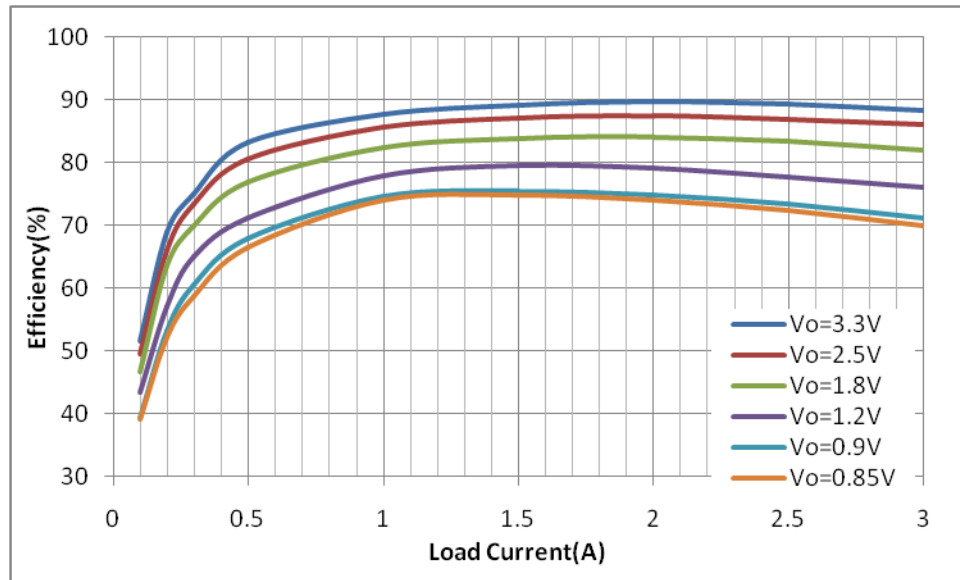


400ns/div

# Rail 3 Efficiency and Transient Results

Testing condition: MPM3632C,  $V_{IN}=12V$ ,  $V_{OUT}=1.8V$ ,  $f_{SW}=3000kHz$ ,  
47uF ceramic output capacitor

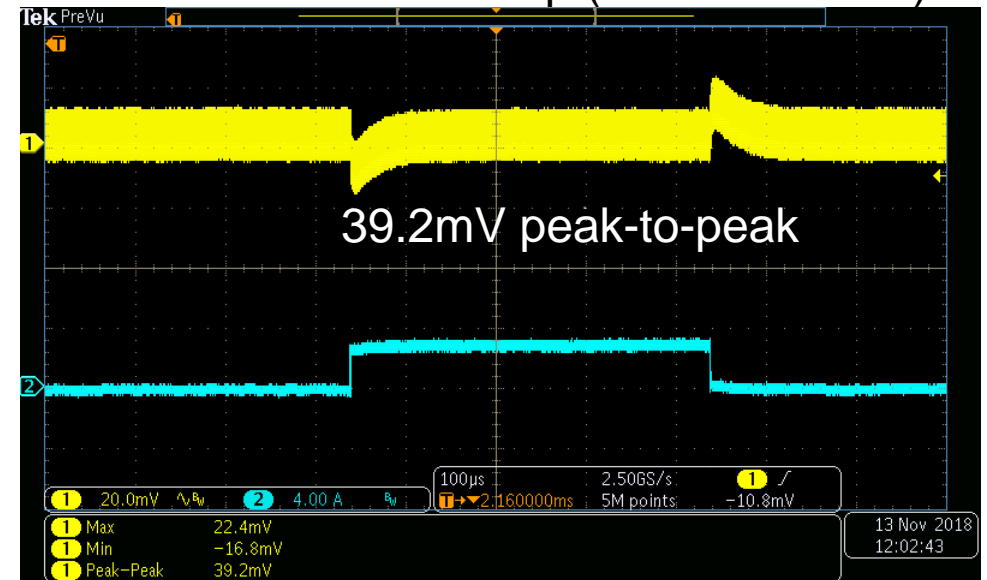
### Efficiency vs. Load Current



CH1:  
 $V_{OUT}/AC$   
Coupled,  
20mV/Div

CH2:  $I_{OUT}$ ,  
4A/Div

### Load Transient Waveform 90% load step (2.7A at 10A/us)



100us/div

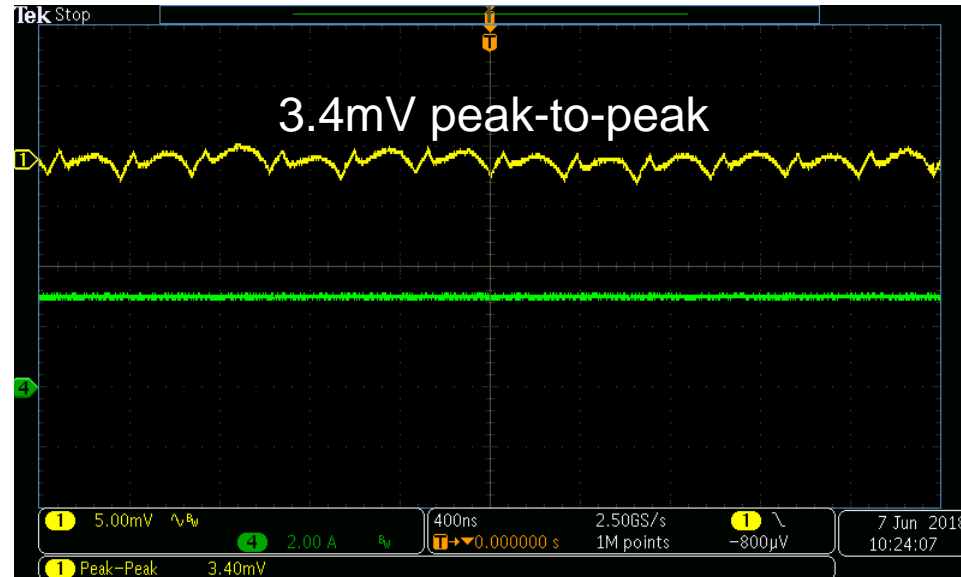
# Rail 3 Output Voltage Ripple

Testing condition: MPM3632C,  $V_{IN}=12V$ ,  $V_{OUT}=1.8V$ ,  $f_{SW}=3000kHz$ ,  
47 $\mu$ F ceramic output capacitor

Output Voltage Ripple at 3A Load

CH1:  
 $V_{OUT}/AC$   
Coupled,  
5mV/Div

CH4:  
 $I_{OUT}$ ,  
2A/Div

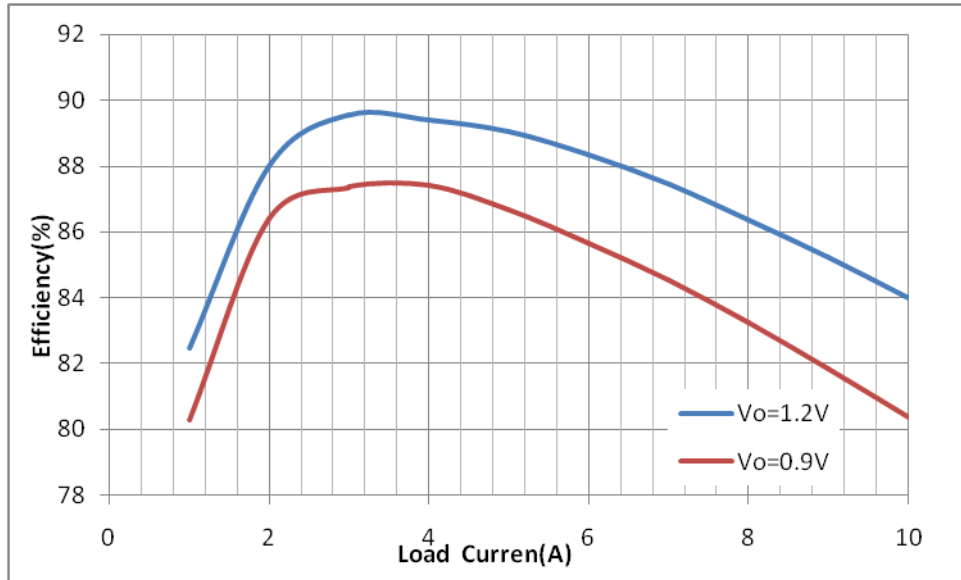


400ns/div

# Rail 4 Efficiency and Transient Results

Testing condition: MPM3683-7,  $V_{IN}=12V$ ,  $V_{OUT}=1.2V$ ,  $f_{SW}=1000kHz$ ,  
6x47uF ceramic output capacitors

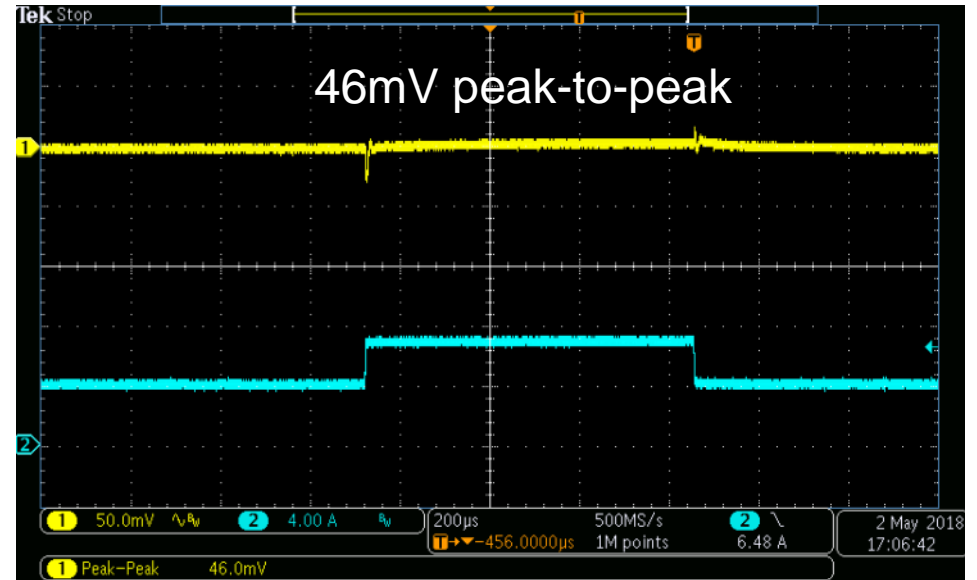
### Efficiency vs. Load Current



### Load Transient Waveform 25% load step (1.75A at 10A/us)

CH1:  
 $V_{OUT}/AC$   
Coupled,  
50mV/Div

CH2:  $I_{OUT}$ ,  
4A/Div



200us/div

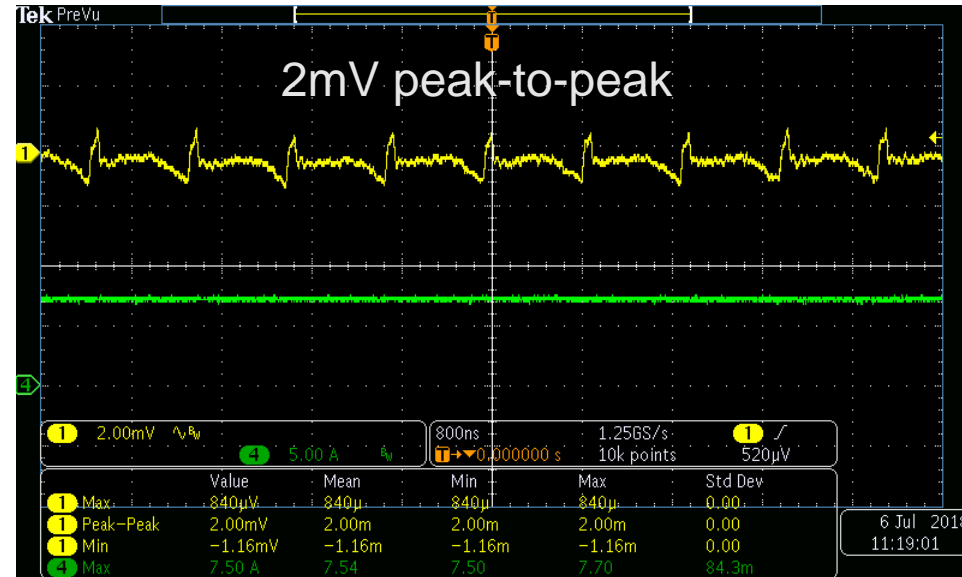
# Rail 4 Output Voltage Ripple

Testing condition: MPM3683-7,  $V_{IN}=12V$ ,  $V_{OUT}=1.2V$ ,  $f_{SW}=1000kHz$ ,  
6x47uF ceramic output capacitors

### Output Voltage Ripple at 7A Load

CH1:  
 $V_{OUT}/AC$   
Coupled,  
2mV/Div

CH4:  
 $I_{OUT}$ ,  
2A/Div



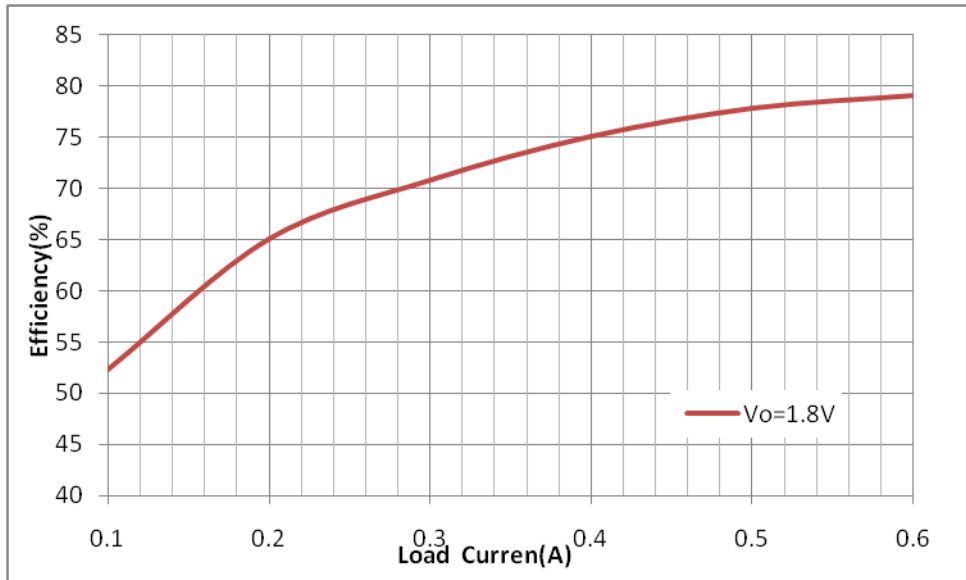
800ns/div



# Rail 5 Efficiency and Transient Results

Testing condition: MPM3606,  $V_{IN}=12V$ ,  $V_{OUT}=1.8V$ ,  $f_{SW}=2000kHz$ , 47uF ceramic output capacitor

### Efficiency vs. Load Current

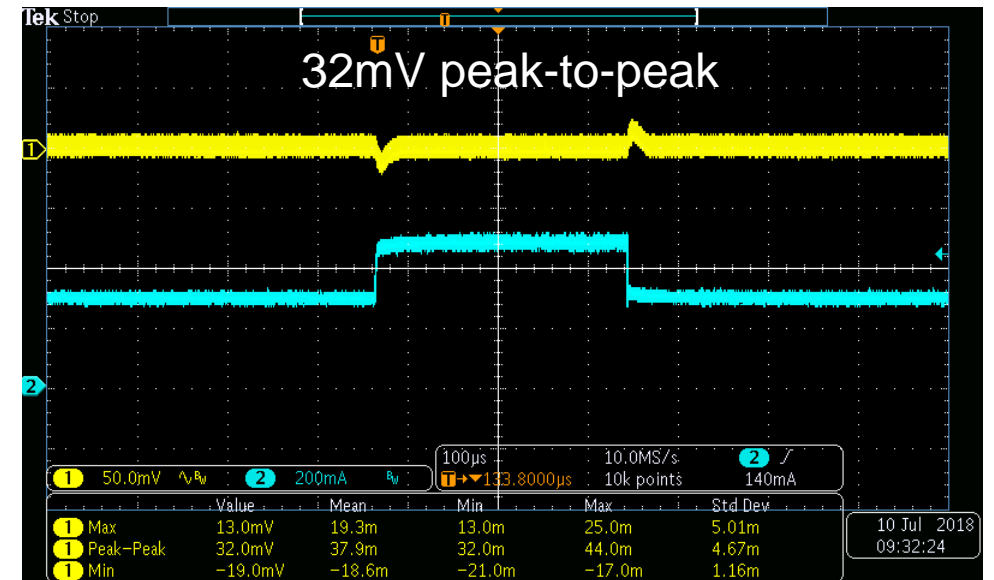


CH1:  
 $V_{OUT}/AC$   
Coupled,  
50mV/Div

CH4:  $I_{OUT}$ ,  
0.2A/Div

### Load Transient Waveform

$I_{OUT}$ , 25% load step (0.15A at 10A/us)



80us/div

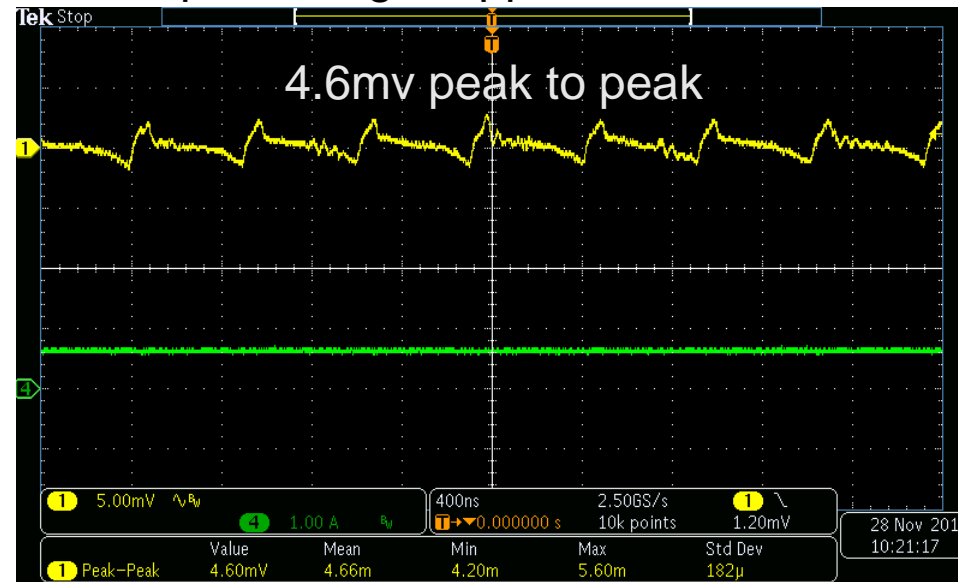
# Rail 5 Output Voltage Ripple

Testing condition: MPM3606,  $V_{IN}=12V$ ,  $V_{OUT}=1.8V$ ,  $f_{SW}=2000kHz$ ,  
47uF ceramic output capacitor

Output Voltage Ripple at 0.6A Load

CH1:  
 $V_{OUT}/AC$   
Coupled,  
5mV/Div

CH4:  
 $I_{OUT}$ ,  
1A/Div

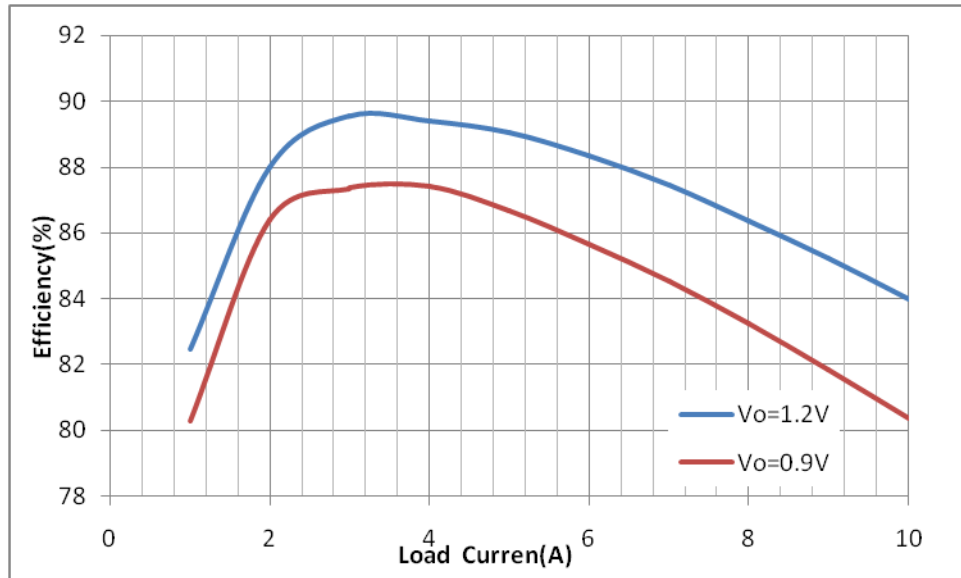


400ns/div

# Rail 6 Efficiency and Transient Results

Testing condition: MPM3683-7,  $V_{IN}=12V$ ,  $V_{OUT}=0.9V$ ,  $f_{SW}=1000kHz$ ,  
6 x 47uF ceramic output capacitors

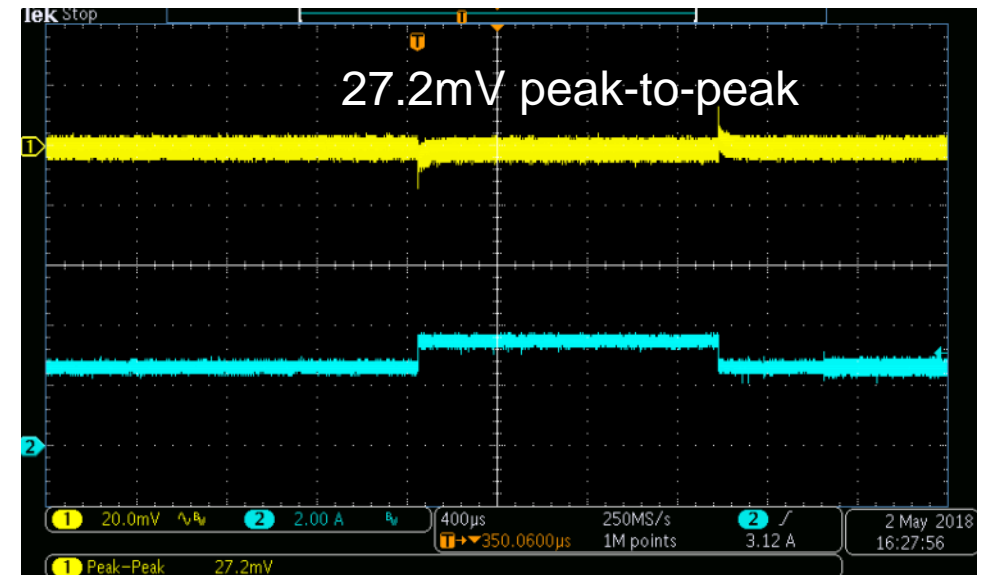
### Efficiency vs. Load Current



CH1:  $V_{OUT}/AC$   
Coupled,  
20mV/Div

CH2:  $I_{OUT}$ ,  
2A/Div

### Load Transient Waveform 25% load step (0.75A at 10A/us)



400us/div

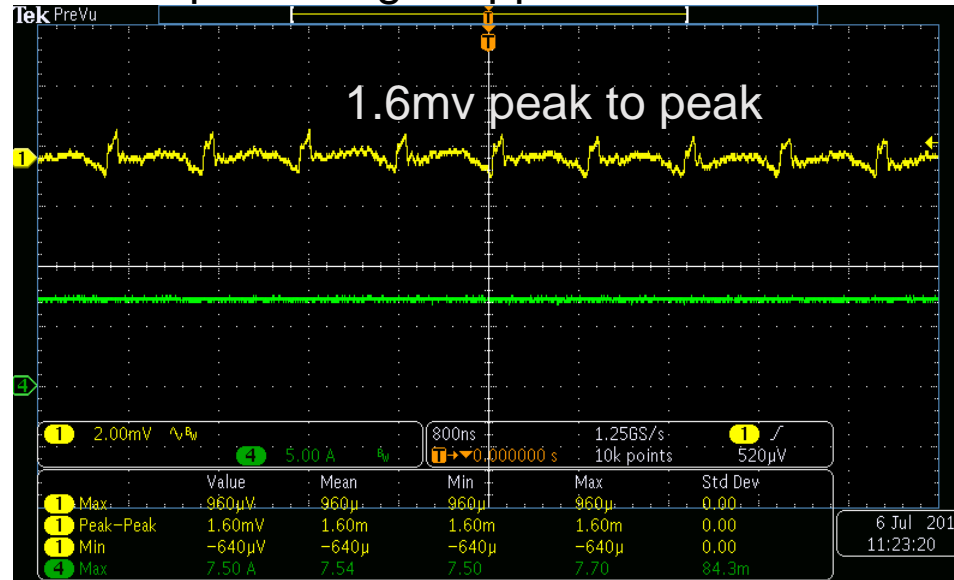
# Rail 6 Output Voltage Ripple

Testing condition: MPM3683-7,  $V_{IN}=12V$ ,  $V_{OUT}=0.9V$ ,  $f_{SW}=1000kHz$ ,  
6 x 47uF ceramic output capacitors

Output Voltage Ripple at 7A Load

CH1:  
 $V_{OUT}/AC$   
Coupled,  
2mV/Div

CH4:  $I_{OUT}$ ,  
5A/Div

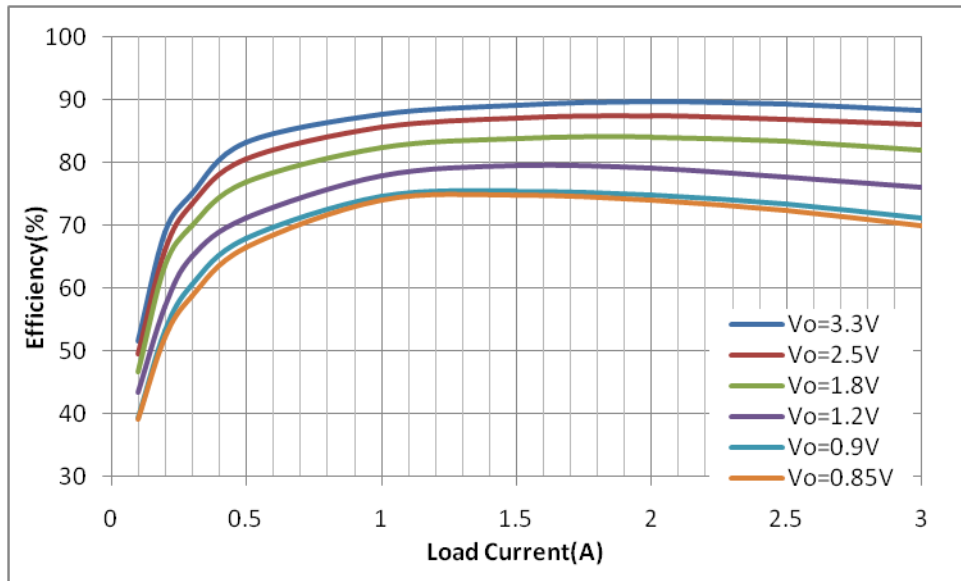


800ns/div

# Rail 7 Efficiency and Transient Results

Testing condition: MPM3632C,  $V_{IN}=12V$ ,  $V_{OUT}=3.3V$ ,  $f_{SW}=3000kHz$ ,  
47uF ceramic output capacitor

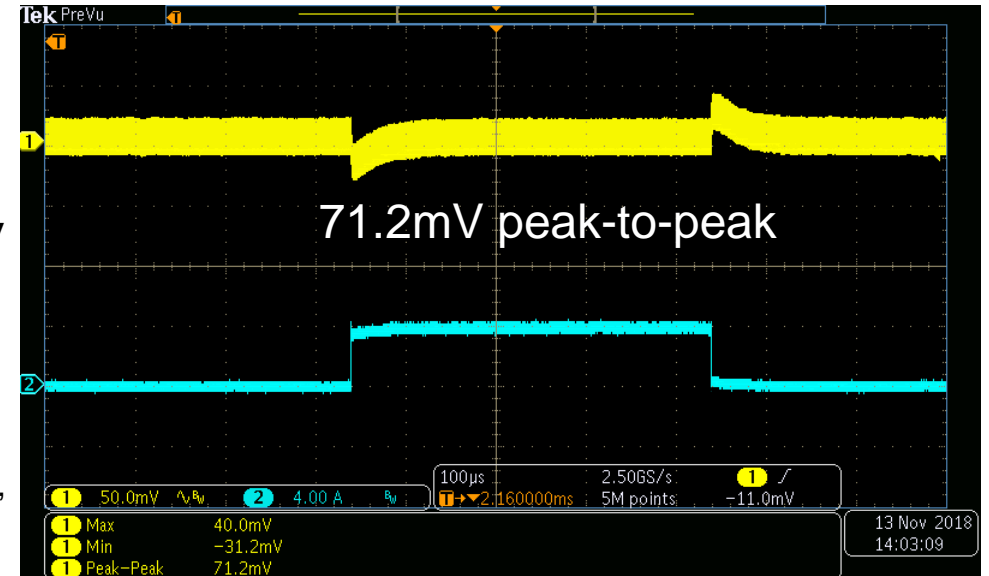
### Efficiency vs. Load Current



### Load Transient Waveform 90% load step (2.7A at 10A/us)

CH1:  
 $V_{OUT}/AC$   
Coupled,  
50mV/Div

CH4:  $I_{OUT}$ ,  
4A/Div



100us/div

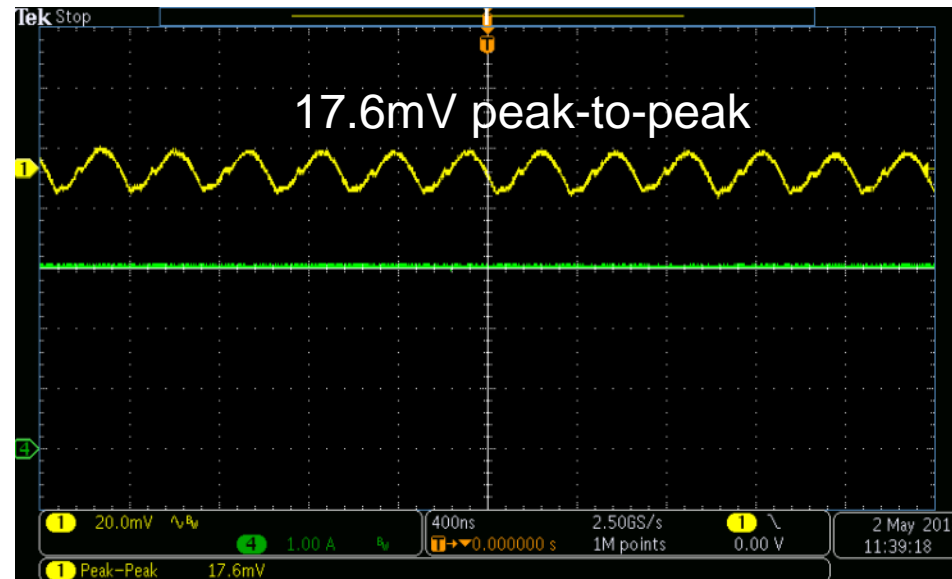
# Rail 7 Output Voltage Ripple

Testing condition: MPM3632C,  $V_{IN}=12V$ ,  $V_{OUT}=3.3V$ ,  $f_{SW}=3000kHz$ ,  
47uF ceramic output capacitor

Output Voltage Ripple at 3A Load

CH1:  
 $V_{OUT}/AC$   
Coupled,  
20mV/Div

CH4:  
 $I_{OUT}$ ,  
1A/Div

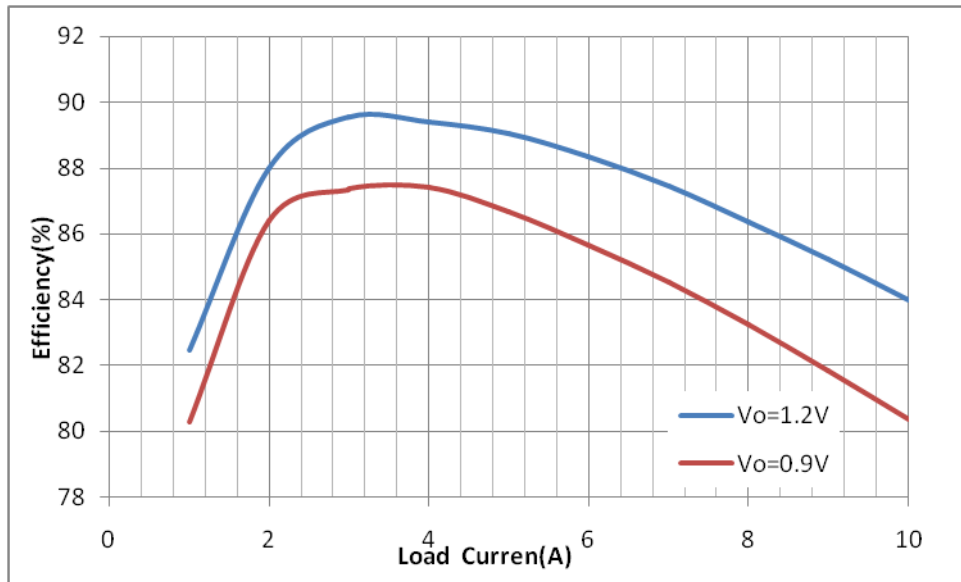


400ns/div

# Rail 8 Efficiency and Transient Results

Testing condition: MPM3683-7,  $V_{IN}=12V$ ,  $V_{OUT}=1.2V$ ,  $f_{SW}=1000kHz$ ,  
6x47uF ceramic output capacitors

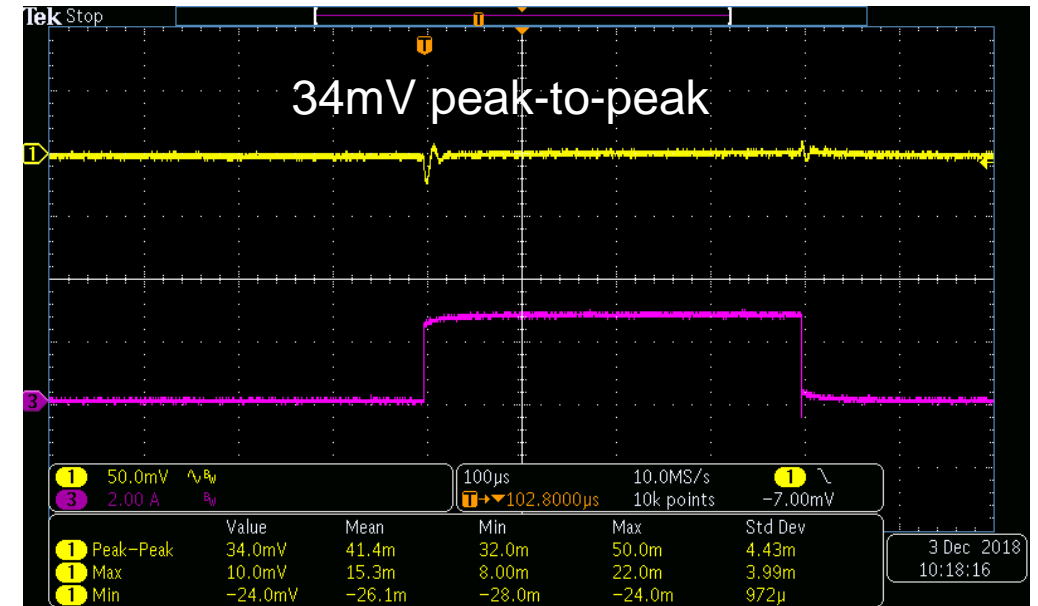
### Efficiency vs. Load Current



CH1:  
 $V_{OUT}/AC$   
Coupled,  
50mV/Div

CH2:  $I_{OUT}$ ,  
2A/Div

### Load Transient Waveform 80% load step (2.4A at 10A/us)



200us/div

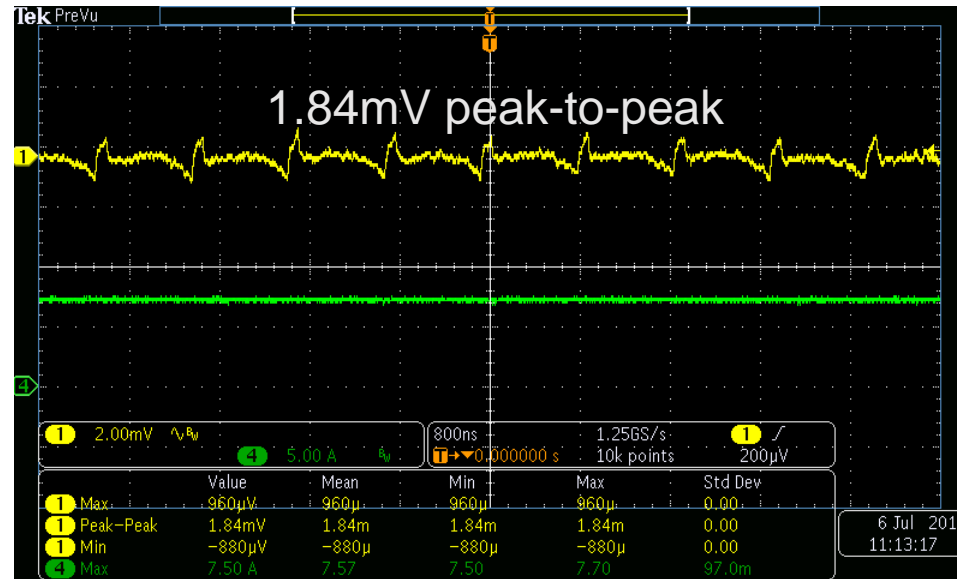
# Rail 8 Output Voltage Ripple

Testing condition: MPM3683-7,  $V_{IN}=12V$ ,  $V_{OUT}=1.2V$ ,  $f_{SW}=1000kHz$ ,  
6x47uF ceramic output capacitors

Output Voltage Ripple at 7A Load

CH1:  
 $V_{OUT}/AC$   
Coupled,  
2mV/Div

CH4:  
 $I_{OUT}$ ,  
2A/Div



800ns/div